Analysis and Planning

How operations analysis can support the Marine Corps Planning Process

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The Marine Corps Planning Process (MCPP) is used to plan military operations throughout the Marine Corps. Scales can range from company-level raids to large joint and combined phased operations. Inherent within such planning is a desire to ease uncertainty and identify structure within an often complex situation. A relevant, precise analysis that explains these complexities is essential to success. Operations analysts within the military are trained and equipped to perform this task. Their support within the MCPP can result in less ambiguity and more assurance among planning factors that influence a commander's decision. This is especially true during the COA (course of action) wargaming step of the MCPP. The purpose of this article is to define how operations analysts can most effectively provide this support.

Background

Operations analysis is a broad field of study often synonymously referred to as big data analytics, decision science, management science, operations research, or systems engineering. For this article, operations analysis is defined as the quantitative study of problems to provide a rational basis for decision making. Operations analysts primarily use three specific tools for analysis. The first tool, statistical analysis, is simply the use of data to draw correlations and inferences. Statistical analysis is wholly dependent on available data, and *more* is almost always *better* when it comes to data. The second tool, optimization, is the maximization or minimization of a variable under a set of constraints. Optimization is often used to improve logistics throughput or aircraft scheduling. The last tool, simulation, uses mathematical models to experiment with a process. Simulation models are based on a set of actions and their associated probabilities. They are commonly used to represent complex relationships between multiple processes that cannot be represented with traditional mathematical methods.

Though largely thought of as experts of Microsoft Excel, operations analysts are much more than that. They combine a keen sense of understanding interactive systems with a highly proficient familiarity of mathematical modeling tools to provide relevance and context to numerical results. Unfortunately, their

Marines maneuver to gain advantage. *(Photo by Cpl Jocelyn Ontiveros.)*

skills are often misunderstood, and they can be underutilized.

Operations analysts within the Marine Corps mainly reside within the MCCDC (Marine Corps Combat Development Command) OAD (Operations Analysis Directorate). OAD is staffed with a combination of active duty Marines and civilians who hold advanced degrees in operations analysis. They support new concepts within MCCDC and long-term studies requested by the Operating Forces and the Supporting Establishment. Once active duty analysts complete their payback tours at organizations like OAD, most return to their primary MOS within the Operating Forces. This pool of experienced analysts is likely serving on staffs where the use of MCPP is prevalent, so they are in the best position to support MCPP with operations analysis.

Operations analysts solve problems using the scientific method. Coincidentally, the MCPP is a research process that parallels the scientific method. Steps within the scientific method include formulating a research question, developing a hypothesis, testing the hypothesis, analyzing the results, and presenting the conclusions. The steps of the MCPP roughly correlate, as shown in Table 1 below.

These analysts can apply their technical skills to a great effect during the testing of the hypothesis. This is where statistics, optimization, and simulation are used to prove or disprove an assertion. This step runs parallel to COA wargaming within the MCPP. Using the scientific method as a framework, it follows that the most effective employment of an operations analyst during the MCPP is during the COA wargaming step. This is not to say that operations analysts cannot contribute during other steps of the MCPP, but the hypothesis-testing phase highlights an analyst's unique skills.

Resupply is required to sustain the force. *(Photo by Ricky S. Gomez.)*

Course of Action Wargaming

A typical wargame is conducted on a large map where friendly and enemy actors take turns moving units and evaluating the outcomes. Each turn includes a friendly action, an enemy action, and a friendly counteraction. Each action should include an analysis of the effects on each warfighting function. The wargame should expose concerns like logistical shortfalls, loss of tempo, overwhelming enemy strength, or key gaps in the awareness of the operational environment.

The goal of wargaming is not for either side to outwit the other but rather to methodically conceptualize each of the major actions of the operation, analyze significant details, and improve the plan. In most cases, a free-text journal of entries (often called a wargaming synchronization matrix) is the only output of this step in the MCPP. An independent evaluation of each COA, as well as a comparison of each COA, is presented in the subsequent step of MCPP, COA comparison and decision. The foundation of this step is based on the results of the wargame. Little analytical rigor supports most of the conclusions drawn from typical wargames, and many practitioners find the step to be fruitless altogether for this reason. Even in cases where analysis is conducted, the largely qualitative, subjective nature of the results will lead many commanders to almost disregard their staffs' recommendations in favor of their subordinate commanders' feedback.

Several opportunities exist for operations analysts to improve this process. A method to categorize these contributions is through the use of the well-known six warfighting functions that "encompass all military activities performed in the battlespace." They are C^2 (command and control), maneuver, fires, intelligence, logistics, and force protection. C^2 is a combination of the legal authority of the commander and a two-way control feedback system that results in unity.[1] Maneuver is a movement or action in "any dimension" to gain an advantage.[2] Dimensions can include space, time, technology, or psy-

MCPP	Scientific Method
Problem Framing	Formulate Research Question
COA Development	Develop Hypothesis
COA Wargaming	Test Hypothesis
COA Comparison and Decision	Review the Results
Orders Development/Transition	Present the Conclusions

Table 1: Correlation between MCPP and the scientific method.

chology. Fires are focused on directly affecting a target through lethal or nonlethal means.[3] Intelligence is primarily focused on understanding the enemy.[4] Logistics is directed at the movement and sustainment of the force.[5] Force protection is the protection of military personnel from natural or adversarial threats.[6]

During wargaming, C^2 is primarily related to the organization of the force, the commander's ability to control the force, and the communications capabilities used to share information across the battlefield. Optimization techniques can be used to quickly determine the maximum size of the force that can be commanded under a given situation. Within optimization, a slight change of the constraints (also called sensitivity analysis) can determine if the outcome will be changed greatly. This can help a commander understand how resilient his C^2 plan is against changes in the battlespace. Simulation software, such as the Joint Communication Simulation System (JCSS), can be used to determine if the given communications network will allow an adequate exchange of information. Additionally, assessments reports that let the commander know if his plan is accomplishing the mission are also part of C^2. Operations analysts have a long history of working with assessments on staffs in Iraq and Afghanistan, so many are familiar with this field. By using well-defined measures of performance and effectiveness, they can provide a quantifiable basis for a commander's assessment.

Maneuver is generally related to the movement of forces on land and in the air during a wargame. It includes consideration about whether the friendly force possesses enough strength to defeat the enemy at decisive points throughout the operation. This is called a relative combat-power assessment and is generally a highly subjective calculation. In recent years, planners have been relying on a spreadsheet model that claims to produce relative combat-power assessments, but there is little understanding of the mechanics behind this spreadsheet and the assumptions that lay the foundation for the calculation. Operations analysts can add rigor to the relative combat-power assessment by using available data to more accurately determine the probability of the outcome of an engagement. A presentation of different scenarios and their associated probabilities of victory can provide high utility for a decision maker.

The commander must be able to control the force and share information with his units. *(Photo by Cpl Ricky S. Gomez.)*

The fires warfighting function encompasses the use of surface and aviation fires to support the operation. Fire support tasks are often assigned to artillery and aviation units without fully understanding if enough ammunition and delivery systems are available to accomplish the task. An assumption is often made that such shortages will not occur. This is likely a holdover mentality from the Iraq and Afghanistan era where resource shortfalls were often not a concern, especially in later years. Instead, operations analysts can use tools to summarize the data over a time period with simple statistics that clearly communicate capacities and capabilities. They can also create scheduling models that can accept a predetermined assignment of fire support missions and calculate the resources necessary at specific times to meet those requirements.

Intelligence is focused on developing information related to the enemy. Intelligence analysts thrive on large amounts of raw data that they eventually convert into relevant information. Much of this information is qualitative in nature. It is typically characterized by long text summaries, often called intelligence summaries, that draw a prediction about future enemy behavior at the end. They occasionally include a graph that shows a change in some particular enemy action against friendly troops over a given time period. Operations analysts can help to improve these intelligence summaries by conducting statistical hypothesis testing against the intelligence analyst's prediction. This is done by quantifying the present and future states by retrieving a few key indicators. The result is a probability score that either accepts or rejects the hypothesis that there will be no change in the present state. Such a conclusion could certainly add validity to an intelligence summary.

Logistics is focused on monitoring capacities and capabilities to support the friendly force. There are endless ways in which an operations analyst can provide assistance in this area because logistics naturally lends itself to quantifiable conclusions and large amounts of accurate data. In fact, many logisticians are already familiar with the tools that operations analysts use to draw conclusions. Basic summary statistics, like means, modes, and ranges, can probably be calculated by any operator in the

field of logistics. However, variation of the data over time lends itself to more robust statistical calculations in which the existing data is fit to a variety of statistical distributions to determine more accurate future estimates of movement and supplies. Additionally, operations analysts can certainly use optimization techniques to determine the optimal flow of resources across a constrained physical network. They can even use simulation to evaluate an even more complex environment where deterministic factors are not applicable and a set of probabilistic outcomes is preferred.

The sixth and final warfighting function is force protection. A common concern for planners involved with force protection is whether they have adequate friendly force capabilities to defend the rear area of the battlespace. This begins with clearly understanding the capabilities of the friendly force in measurable, quantifiable terms. In most cases, these capabilities are defined in military publications in just this fashion. For instance, a publication on military tactics will likely define how much ground an infantry battalion should be able to defend along a line with no significant terrain features. Assumptions will undoubtedly be required to complete the calculations, but a rigorous methodology can be a useful complement to qualitative intuition.

Challenges

Even though operations analysis can be a very powerful, effective decision-making tool, it can be challenging to incorporate. First, operations analysis cannot produce useful, accurate solutions without an adequate amount of data. When studying processes, much of this required data should come from historical observations. Unfortunately, such data is usually limited, especially in the context of ground maneuver and support. Additionally, most of the available data is not usually quantified in a way that operations analysts can study and compute results. Tools exist to create estimates under such conditions, but they are only as good as the quality of the data. Operations analysts can collect data for study in limited circumstances, but this is not their primary role.

The other main obstacle is the amount of time required to conduct an analysis. Though some operations analysis is largely reliant upon already-established algorithms in Microsoft Excel, most require original scripting and programming that can take days or even weeks. Many simulation tools are already built for analysis, but they often still require the time-consuming input of several strings of data. This presents a challenge for planners because they often only dedicate two or three days to wargaming. A lack of sufficient time can result in inaccurate or impractical results.

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Fortunately, these challenges can be mitigated with preparation. With regard to limited data, a discussion with an operations analyst before the start of the MCPP can help prepare expectations for both the staff and the analyst. The staff can develop the necessary data ahead of time or clarify its availability. The operations analyst can also explain the benefits of the data and the potential solutions that can be provided. Time constraints can also be mitigated with a similar effort. Rather than begin the analysis during wargaming, much of the study can usually be conducted before MCPP ever begins. In particular, the development of algorithms and automated code can be written and ready if the scenario and potential COAs are understood before the beginning of the planning process. Additionally, statistical summaries of steady-state data can also be calculated prior to the start of wargaming.

Conclusion

Operations analysis provides a way to introduce quantitative measurements and analytical rigor into the MCPP. Through the use of statistical analysis, optimization, and simulation, operations analysts can assist planners with establishing numerical estimates of capabilities and outcomes across the six warfighting functions during the wargaming step of the MCPP. Challenges with a lack of time or data can be mitigated with adequate preparation and management of expectations.

Future warfare will involve complexities ranging far beyond customary warfare tactics within the air, land, and sea domains. The growth of information, cyberspace, and space operations will present new challenges to planners with little historical context to rely upon. Scenarios such as these will depend on operations analysis for precise characterizations of complex interactions within the battlespace, particularly during the planning stages of an operation.

Notes

1. Headquarters Marine Corps, *MCDP 1-0, Marine Corps Operations,* Washington, DC: August 2011).

3. Ibid.

4. Ibid.

5. Ibid.

6. Ibid.